4-1-2016

Rerouting Mode Choice Models: How Including Realistic Route Options Can Help Us Understand Decisions to Walk or Bike

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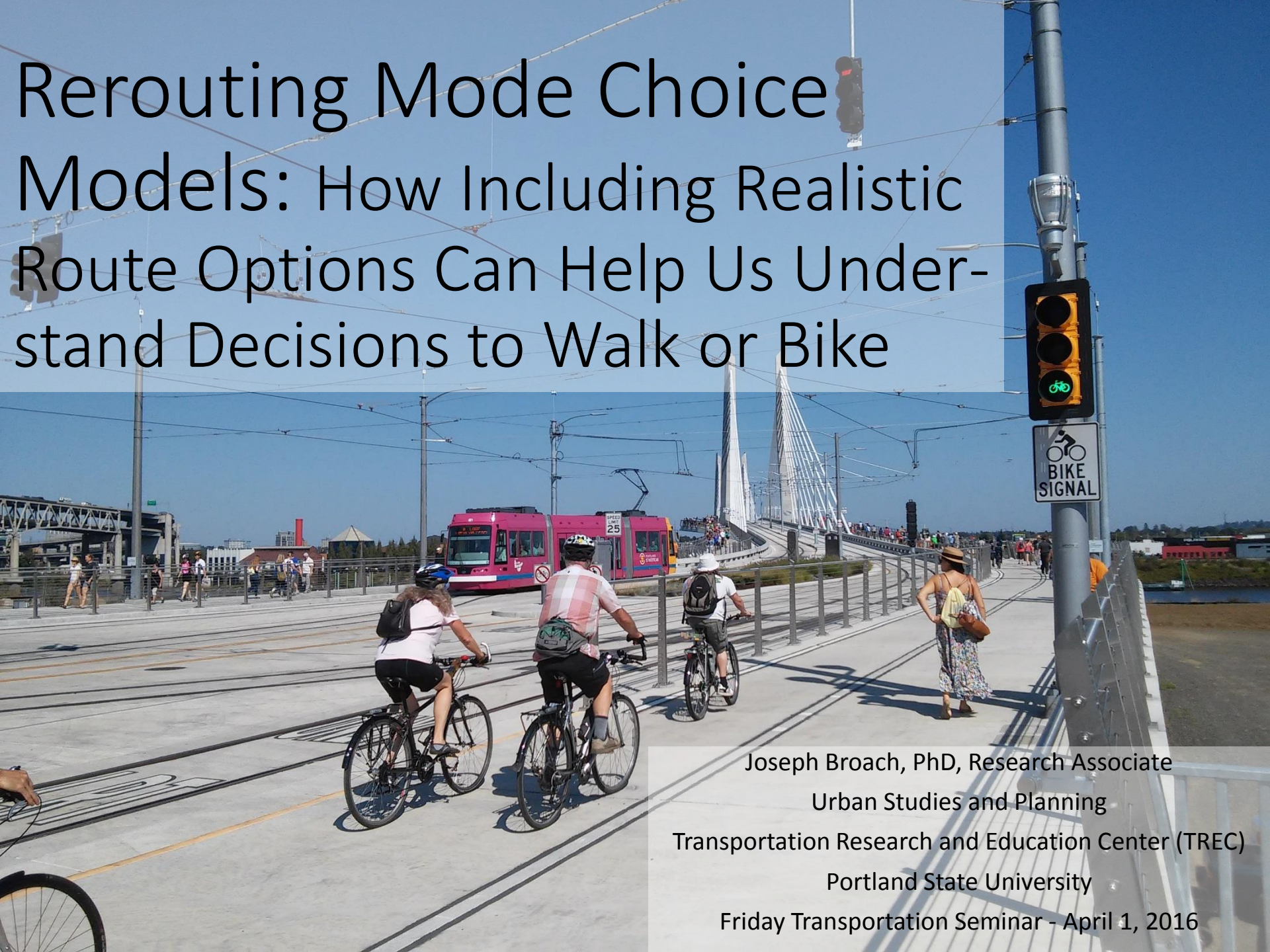

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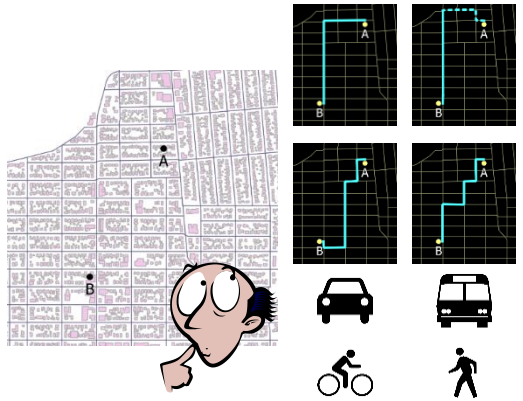
Transportation Research and Education Center (TREC)
Portland State University

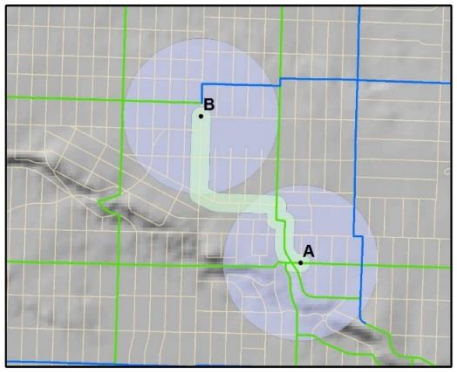
Friday Transportation Seminar - April 1, 2016

Motivation

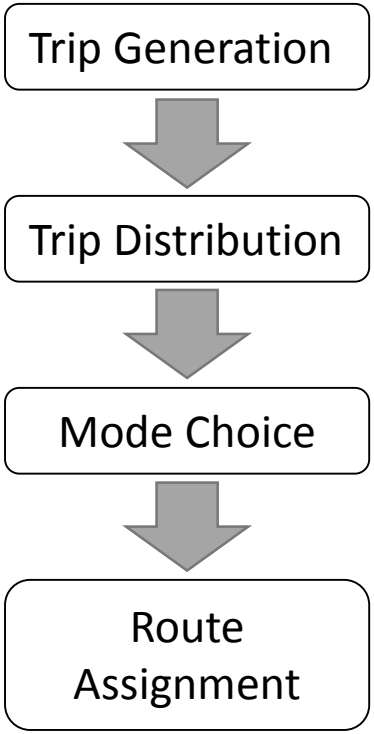


1. Understand behavior

2. Inform policy



3. Improve prediction



The story so far

Revealed Preference
Bike Route Choice
Bike GPS Study

2007-2012

2010-2013

Revealed Preference
Walk Route Choice
Family Activity Study

Transferability of
Bike Route Choice
Preferences

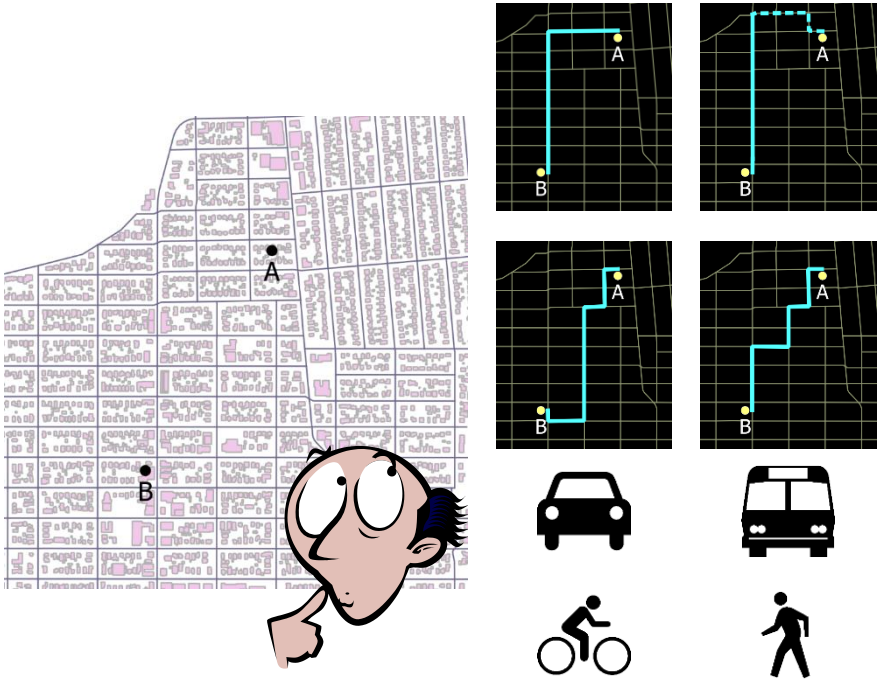
2014

2015-2016

Revealed Preference
Mode Choice

The conceit

1. Given trip from A to B
2. Routes that *would* be taken are considered for each mode
3. Attributes along those routes affect mode choice

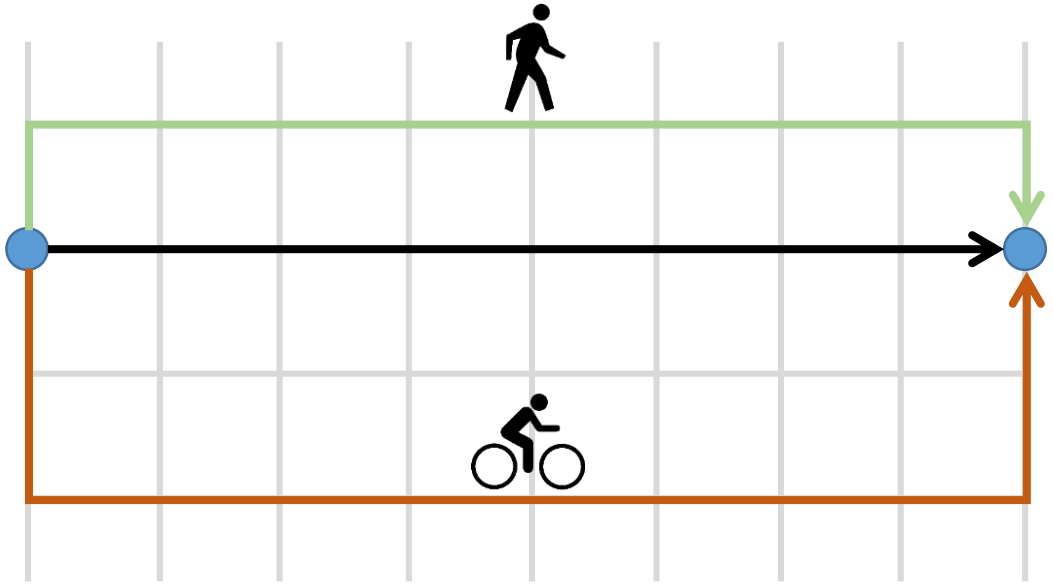


The plot

Given:
Trip from Origin to Destination

Predict:
Highest Utility "Best" Walk and Bike Routes

Estimate:
Maximum Likelihood Mode Choice Utility Function

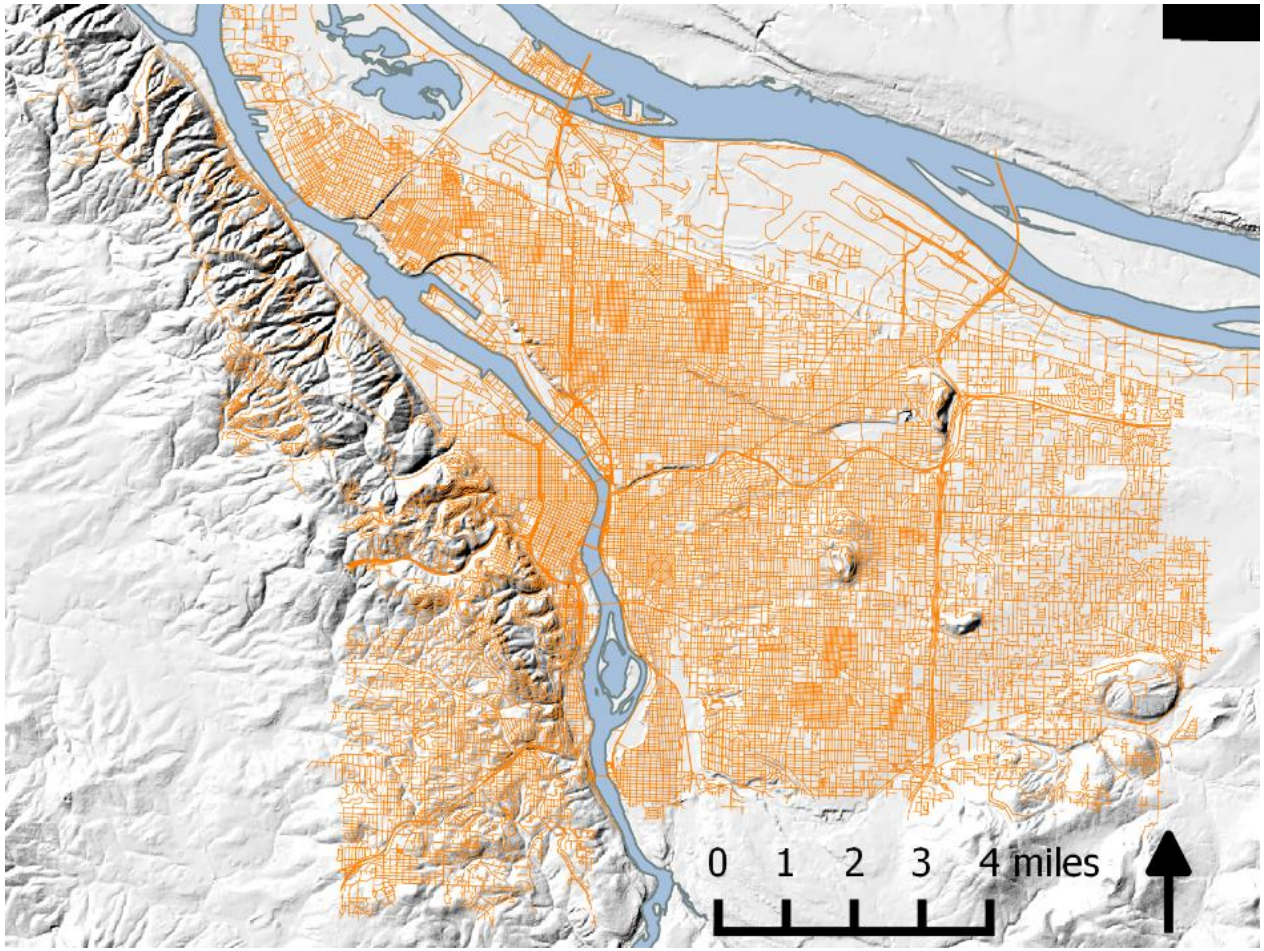


The setting

Only trips starting and ending within the City of Portland

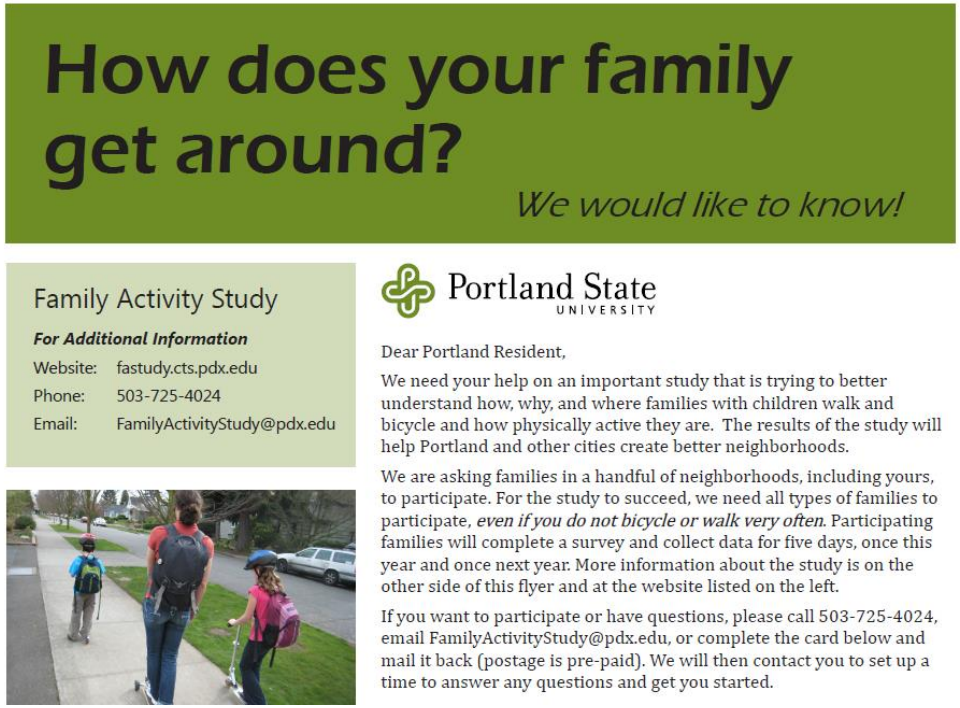
Rich GIS data from Metro & City

- walk/bike network
- facilities
- land-use
- terrain



The characters (1)

Adult participants in the Family Activity Study (2010-2013)



How does your family get around?

We would like to know!

Family Activity Study

For Additional Information

Website: fastudy.cts.pdx.edu
Phone: 503-725-4024
Email: FamilyActivityStudy@pdx.edu

Portland State UNIVERSITY

Dear Portland Resident,

We need your help on an important study that is trying to better understand how, why, and where families with children walk and bicycle and how physically active they are. The results of the study will help Portland and other cities create better neighborhoods.

We are asking families in a handful of neighborhoods, including yours, to participate. For the study to succeed, we need all types of families to participate, *even if you do not bicycle or walk very often.* Participating families will complete a survey and collect data for five days, once this year and once next year. More information about the study is on the other side of this flyer and at the website listed on the left.

If you want to participate or have questions, please call 503-725-4024, email FamilyActivityStudy@pdx.edu, or complete the card below and mail it back (postage is pre-paid). We will then contact you to set up a time to answer any questions and get you started.

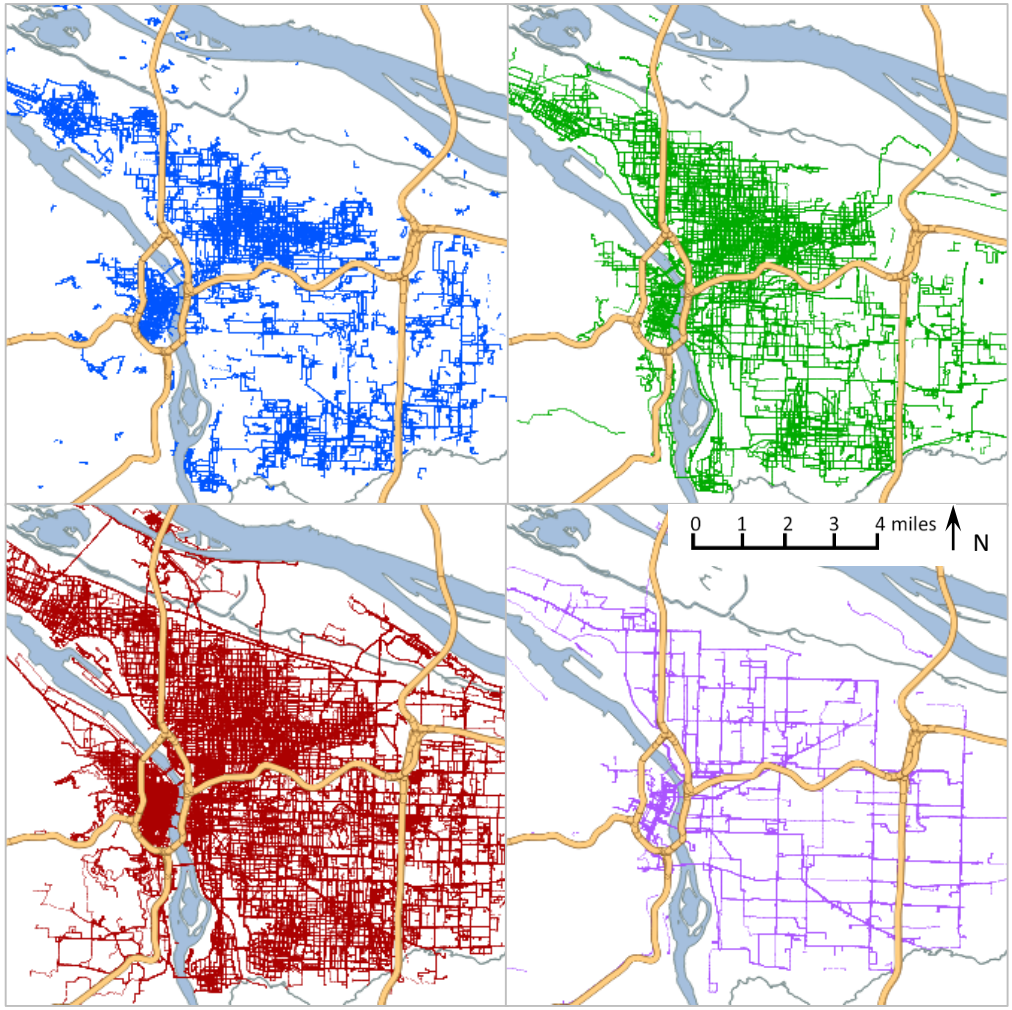
Compared with block group and typical Portland household with children…

- more educated 60% college
- less diverse 85% white
- more women 62% female
- more owners 81% own home
- similar income $50-75k
- more cars 1.7 cars

- more biking 11% trips
- more driving 75% trips

The characters (2)

GPS
Trips
(& tours)



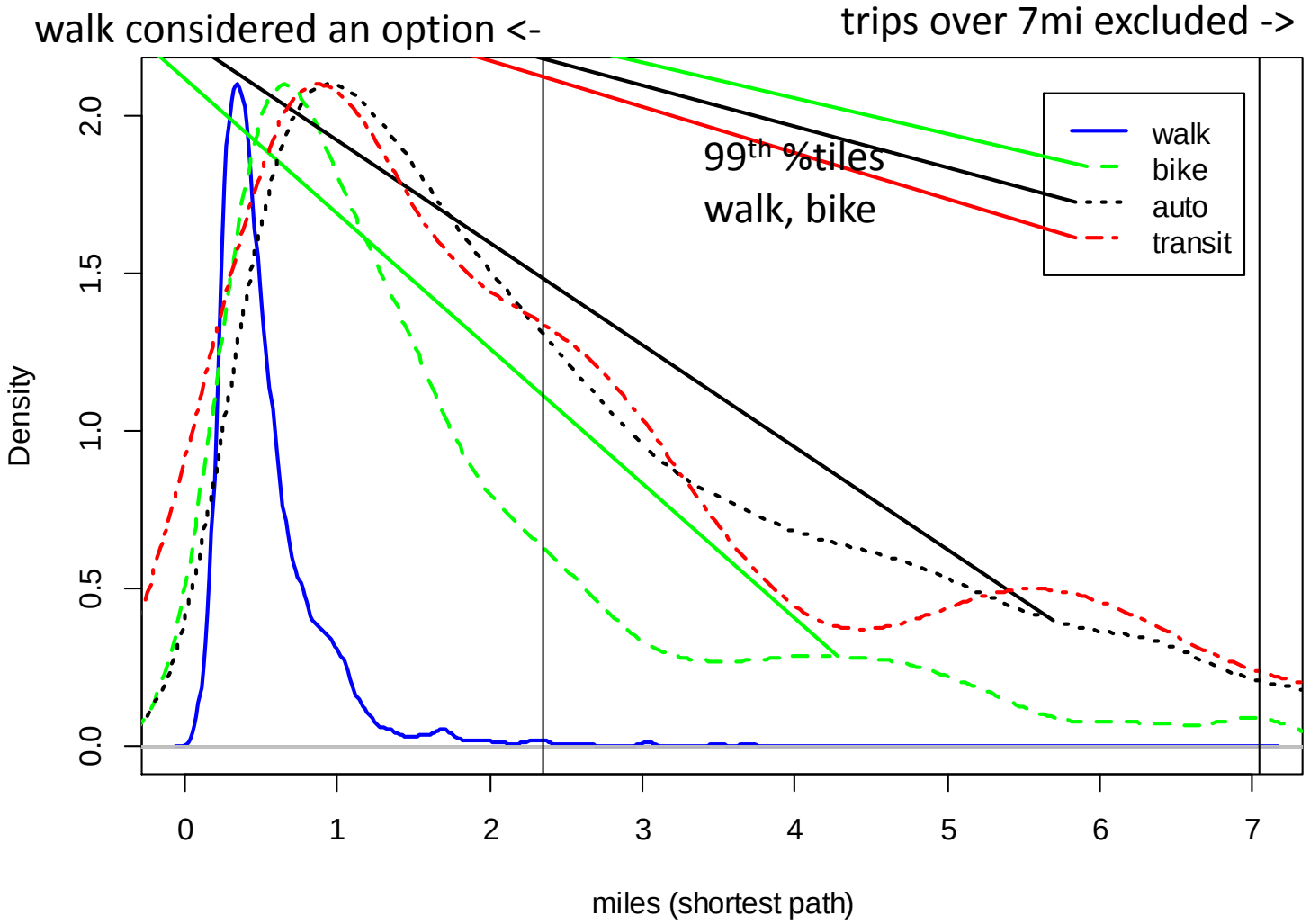
1,419 (11%)

1,501 (11%)

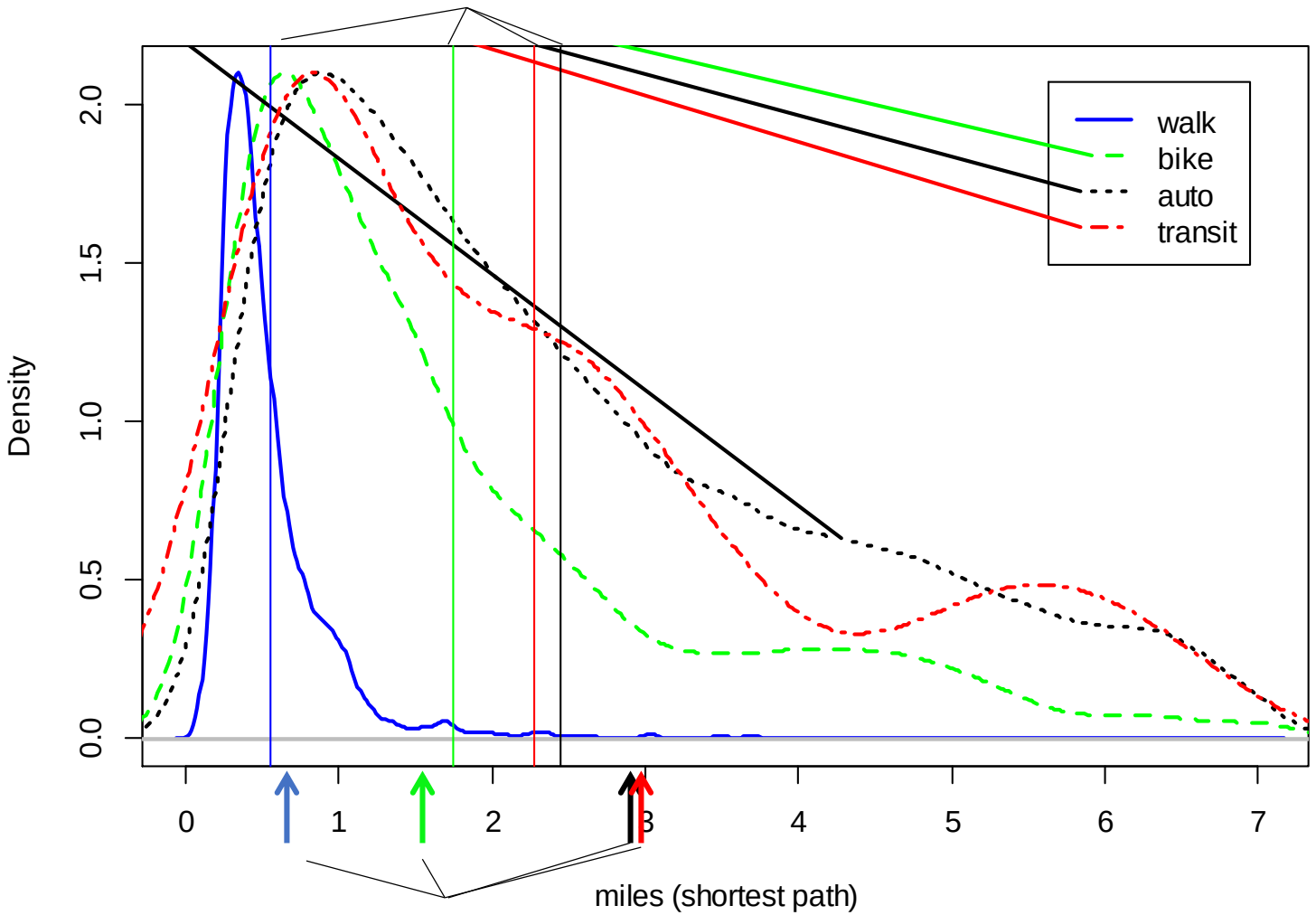
9,957 (75%)

384 (3%)

Editing


walk considered an option <-
trips over 7mi excluded ->
99th %tiles
walk, bike
walk
bike
auto
transit
Density
0.0
0.5
1.0
1.5
2.0
0
1
2
3
4
5
6
7
miles (shortest path)

Editing

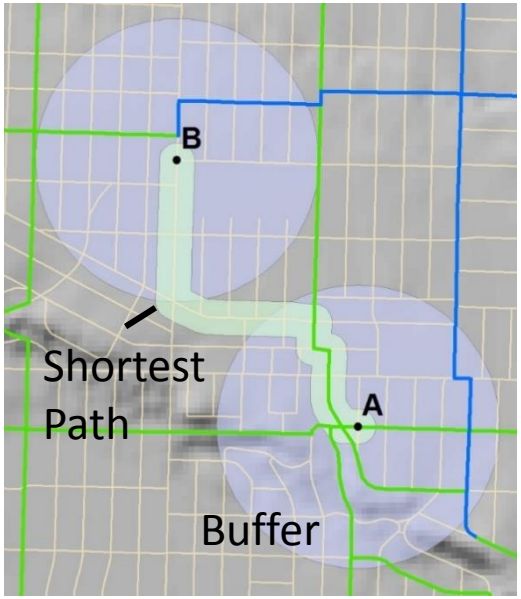


NHTS 2009 (means for trips <= 7mi)

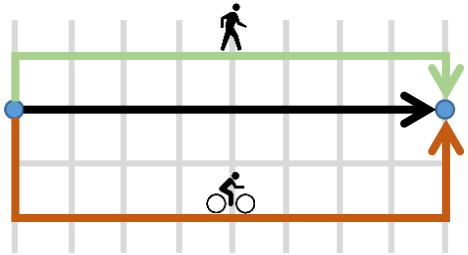
The action

All models include: socio-demographics (gender, car ownership), trip context (purpose, day of week, transit access)

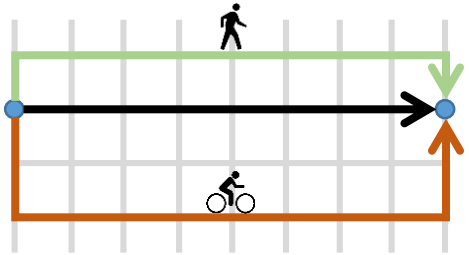
Model 1: Shortest Paths & OD Buffers (0.25-1 mi)



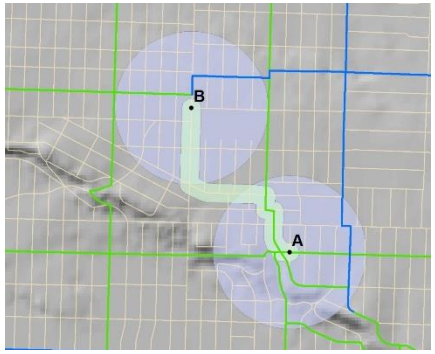
Model 2: Predicted Walk & Bike Routes



Model 3: Combination of Route, OD + Home area

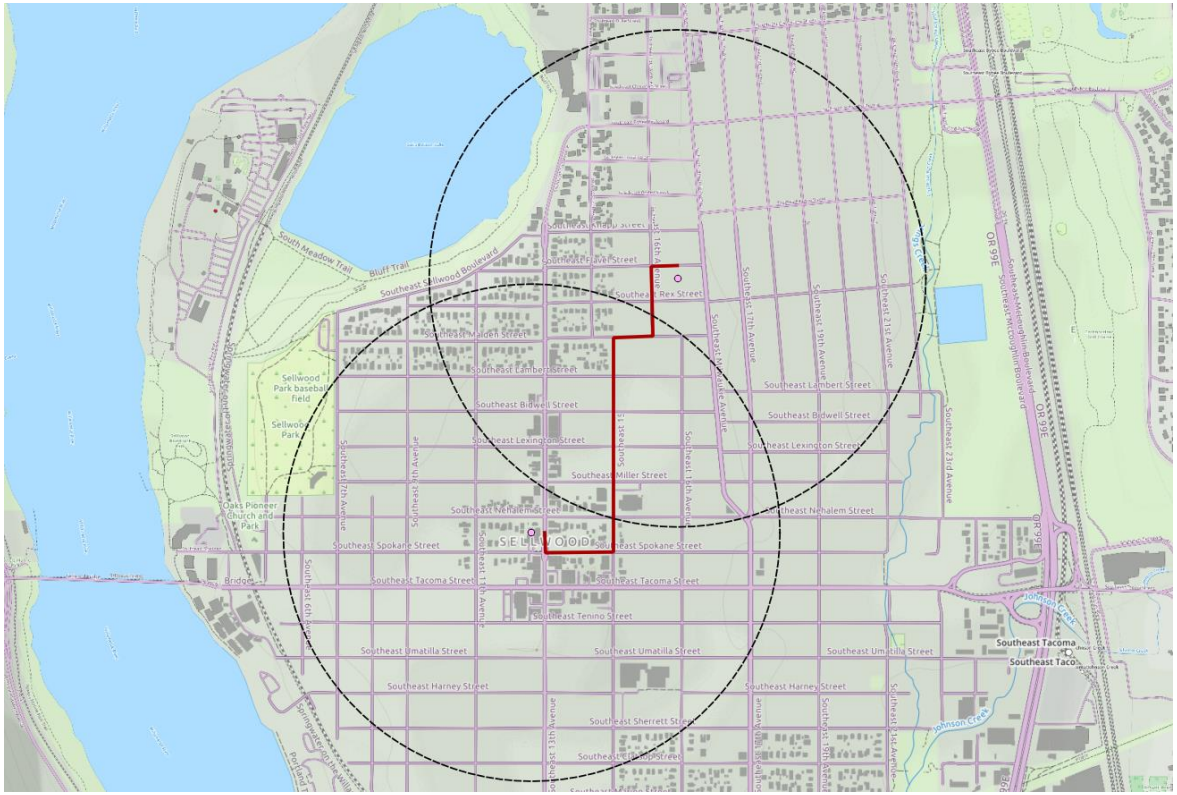


+



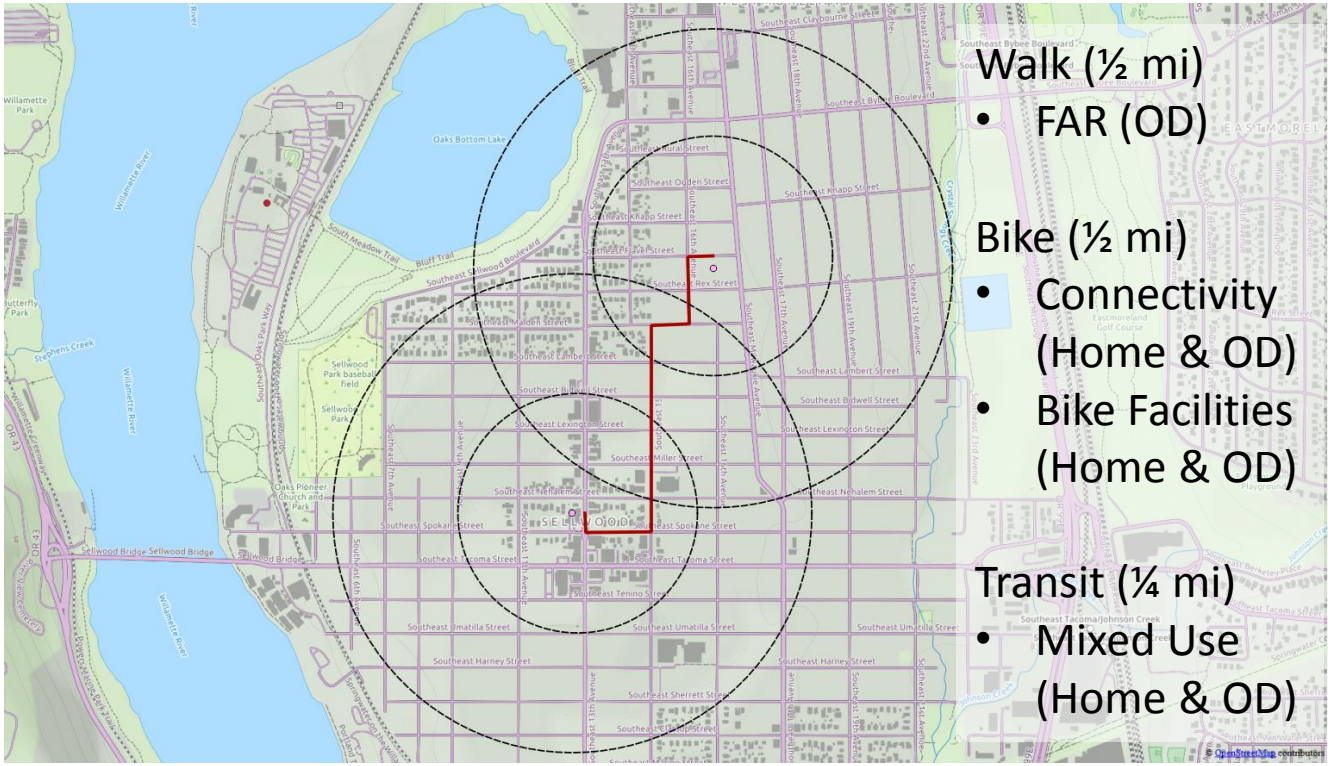
Big reveal #1

Measuring along single best walk & bike routes predicts mode choice significantly better than within origin-destination buffer areas.



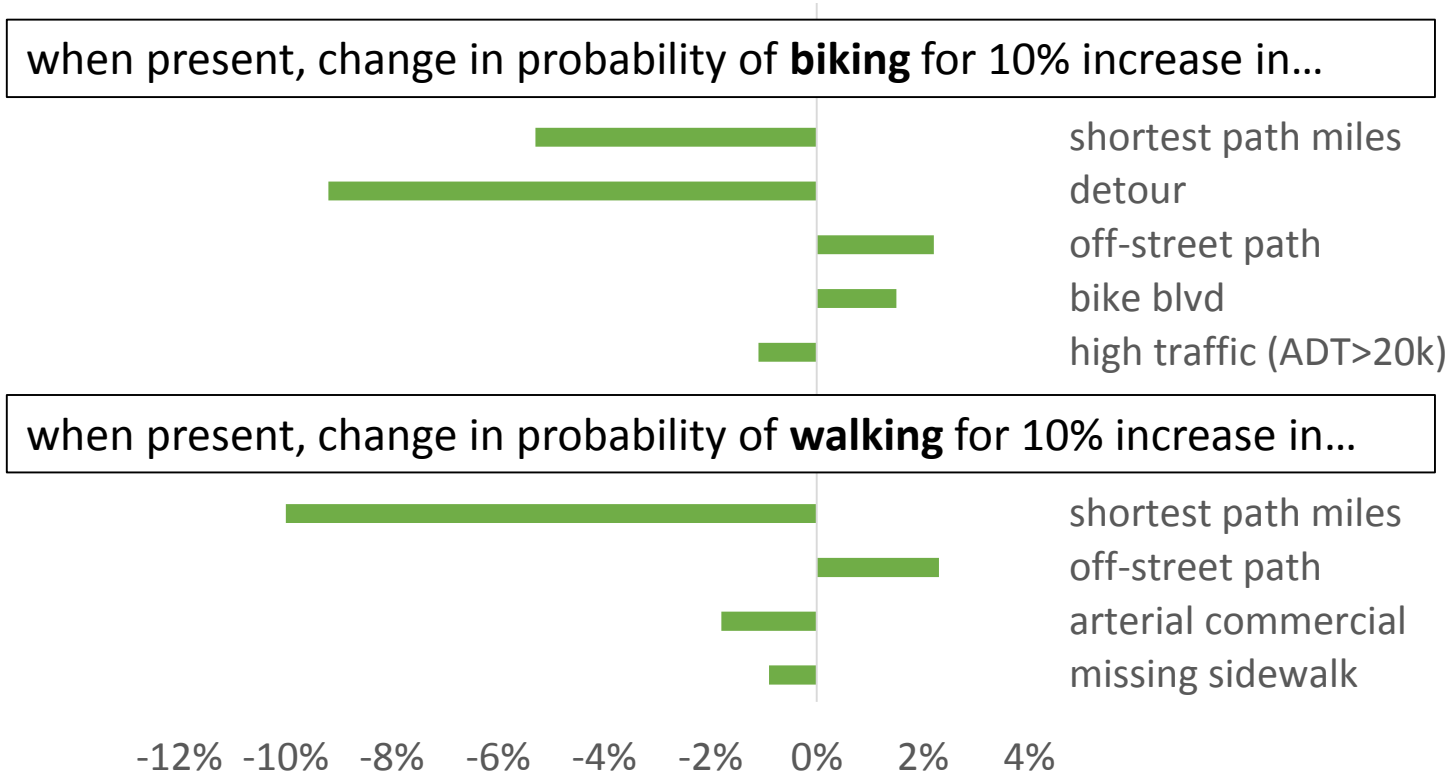
Big Reveal #2

Route and area measures complementary to route measures, in some cases.



Big reveal #3

Bike and walk facilities matter in decisions of *whether* to bike or walk.



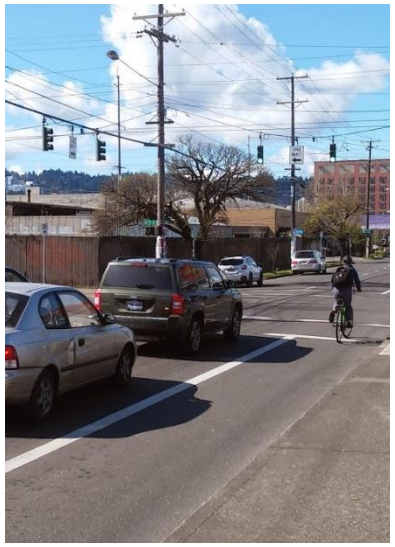
not shown, each arterial crossing without a signal: -31% prob. walking

Big reveal #4

Gender matters for decisions of ***whether*** to bike, unlike decisions of ***where*** to bike.

-38%

Overall, for similar trip



-70%

When “best” route entirely along moderate traffic streets (ADT 5-20k)

+68%

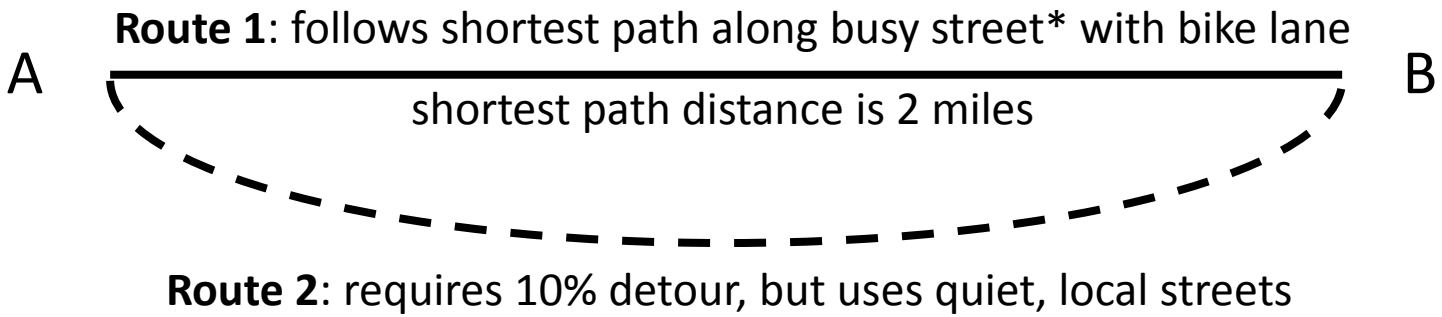
When “best” route entirely along low-traffic bike boulevard

+0%

On trips that cross Willamette River (Men: 2.2x as likely)

Big reveal #5

Sensitivity to corridor-level policies substantially increased using predicted routes.



Initial Probability of Biking ("best" route is Route 1)

	Male	Female
Area Model	1.7%	1.3%
Route Model	**3.1%**	**2.1%**

Probability of Biking w/ proposed bike boulevard treatment along Route 2 ("best" route shifts)

	Male	Female
Area Model	1.7%	1.5%
Route Model	**21.5%**	**30.1%**

* ADT 20k (cars per day)

Plot twist!

- Self-selection: Could those wanting to bike or walk more just live where facilities are better?
- Importance (1-5) in choice of current home…
  - …good walking neighborhood (mean=4.2)
  - …good biking neighborhood (mean=3.8)
- Significant impact but w/in range of travel environment effects (+22% walk, +39% bike)
- Significance and magnitude of route attributes largely unchanged, suggesting complementary effects

Critics always find something!

- Trip-based model (though included tour distance)
- Assumed order entirely destination -> mode
- Panel data (though controlled for time effects)
- Single “best” route for everyone
- Transit/Auto missing variables
- Preferences can only be revealed within existing conditions (new facility types, different urban forms)
- Attitudes not included

Morals of the story

- Quality bike and walk routes not only improve experience on existing trips but also encourage new trips by walking and biking.
- Low traffic-stress facilities are good for all users and may be especially important to encourage women to bike.
- For maximum value, bike facilities should follow shortest paths; however, still have value even when that's not feasible, particularly when other options poor.

Questions? Ideas?

Special thanks to: NITC Dissertation Fellowship
Portland Metro
City of Portland
Jennifer Dill & FAS Team

TREC
Transportation Insight for Vibrant Communities

Portland State
UNIVERSITY

Further reading…

Contact me at jbroach@pdx.edu if you need help accessing any of my articles*:

Bike Route Choice

*Broach, J., Dill, J., & Gliebe, J. (2012). Where Do Cyclists Ride? A Route Choice Model Developed with Revealed Preference GPS Data. *Transportation Research Part A: Policy and Practice*, *46*(10), 1730–1740. http://doi.org/10.1016/j.tra.2012.07.005

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*Broach, J., & Dill, J. (2015). Pedestrian Route Choice Model Estimated from Revealed Preference GPS Data. In *Transportation Research Board 94th Annual Meeting*. Washington, DC. Retrieved from http://trid.trb.org/view.aspx?id=1338221

*Broach, J. P. (2016). *Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes*. Portland State University. Retrieved from http://archives.pdx.edu/ds/psu/16897

Guo, Z., & Loo, B. P. Y. (2013). Pedestrian environment and route choice: evidence from New York City and Hong Kong. *Journal of Transport Geography*, *28*, 124–136. http://doi.org/10.1016/j.jtrangeo.2012.11.013

Rodríguez, D. A., Merlin, L., Prato, C. G., Conway, T. L., Cohen, D., Elder, J. P., … Veblen-Mortenson, S. (2015). *Influence of the Built Environment on Pedestrian Route Choices of Adolescent Girls*. *Environment and Behavior* (Vol. 47). http://doi.org/10.1177/0013916513520004

Mode Choice

*Broach, J. P. (2016). *Travel Mode Choice Framework Incorporating Realistic Bike and Walk Routes*. Portland State University. Retrieved from http://archives.pdx.edu/ds/psu/16897

*Broach, J., & Dill, J. (in press). Using Predicted Bicyclist and Pedestrian Route Choice to Enhance Mode Choice Models. *Transportation Research Record*.

Hood, J., Erhardt, G., Frazier, C., & Schenk, A. (2014). Estimating Emissions Benefits of Bicycle Facilities with Stand-Alone Software Tools: Incremental Nested Logit Analysis of Bicycle Trips in California's Monterey Bay Area. *Transportation Research Record: Journal of the Transportation Research Board*, (2430), pp 124–132. http://doi.org/10.3141/2430-13